Network Addressing

Prepared by : Pr RIAHLA

Network Addressing: Purpose

- **MAC Address**

- **IP Address**

- **Port Number**

Prepared by : Pr RIAHLA

Network Addressing: Types

Device Addressing

Application Addressing

Port Number
Transport Layer

Logical Address

Physical Address

IP Address

Internet Layer (TCP/IP)
Network Layer (OSI)

MAC Address

Network Access Layer (TCP/IP)
Data Link Layer (OSI)

Prepared by : Pr RIAHLA

We'll do a simulation at the end of the class
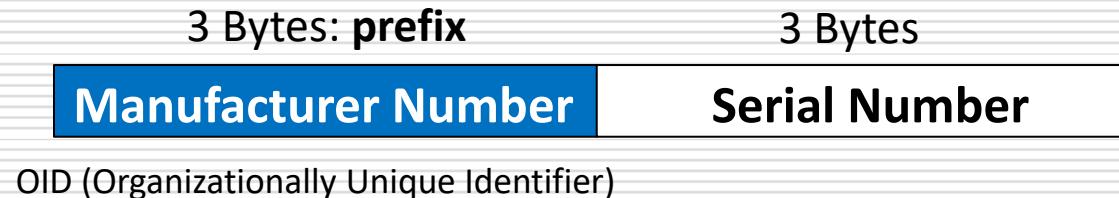
Network Addressing
Physical Addressing (MAC)

MAC address

A MAC address (Media Access Control address) is a unique identifier assigned to each network card or device connected to a local network. This address is used at the Layer 2 (Data Link layer) of the OSI model to uniquely identify a device on a network, such as a computer, router, printer, or even a smartphone.

MAC address
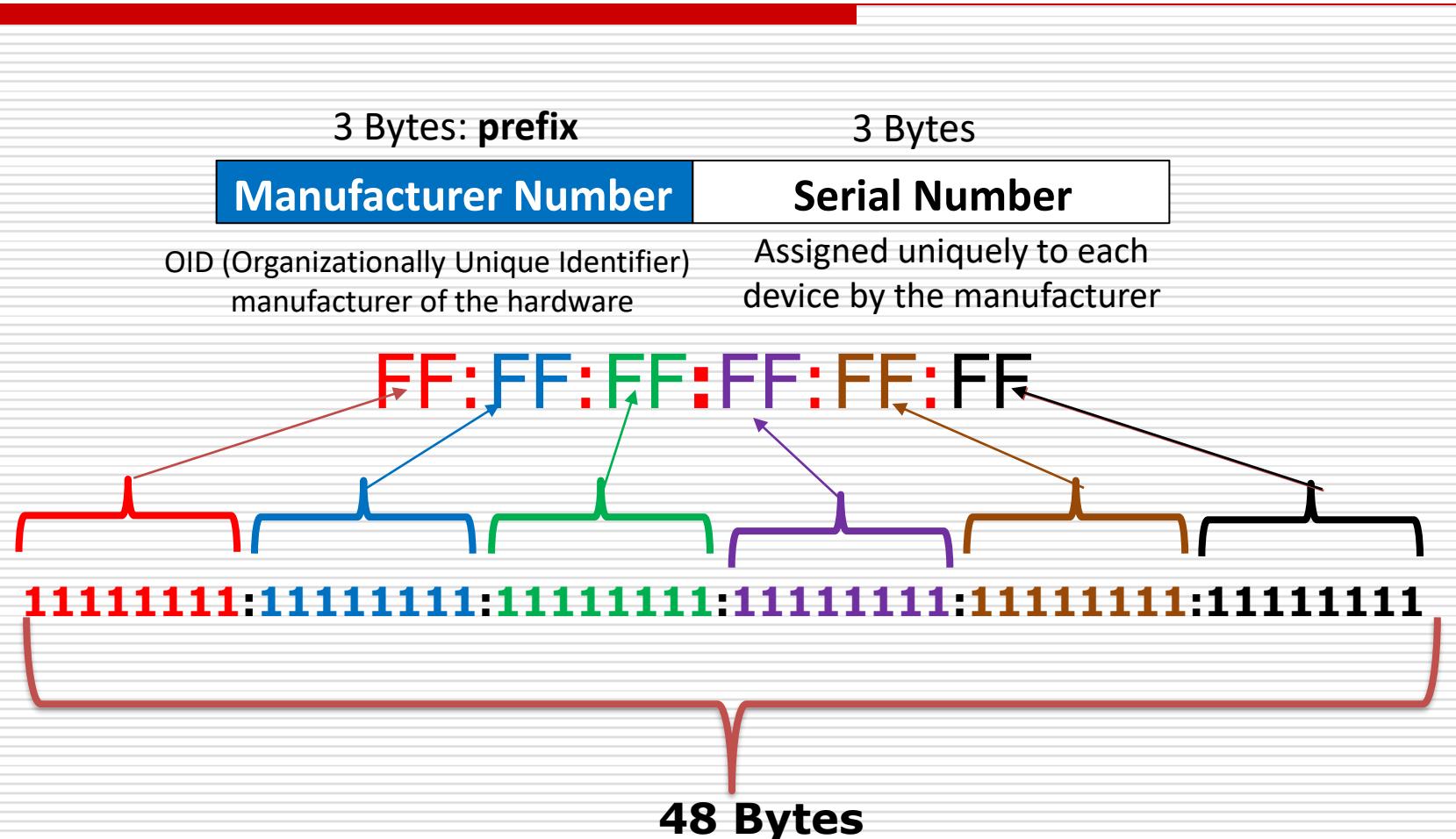
- A device has a unique worldwide address (fixed MAC address).
- IEEE 802.3 addresses are encoded on 48 bits (6 bytes).

3 Bytes: **prefix**	3 Bytes
Manufacturer Number	**Serial Number**

OID (Organizationally Unique Identifier)
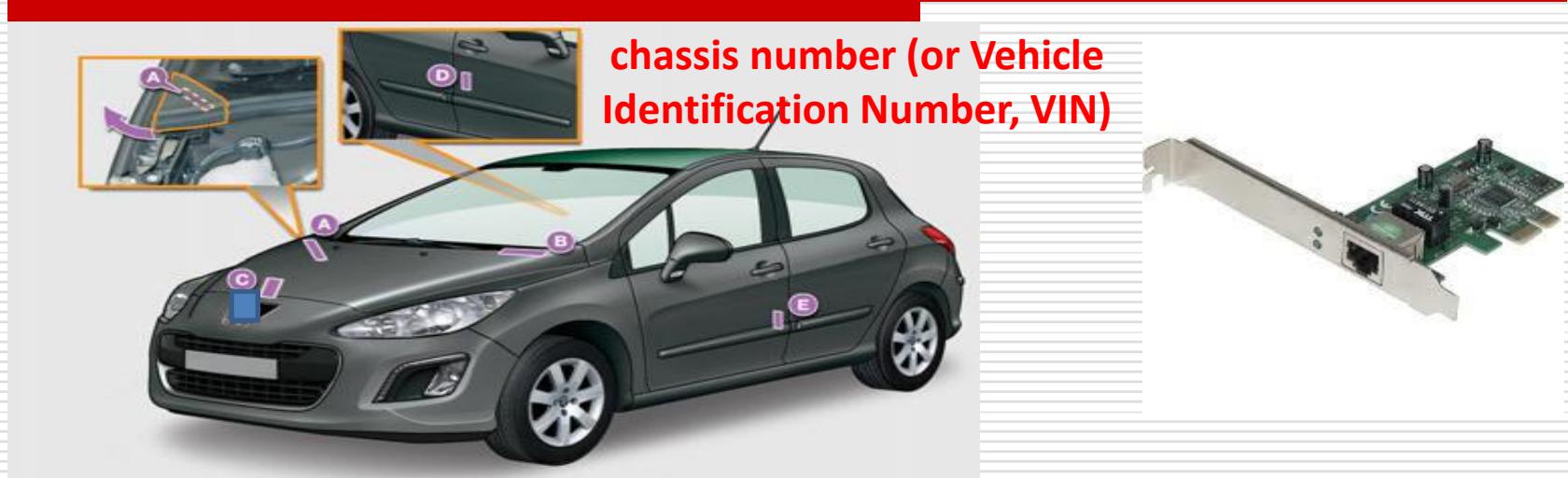
08:00:20:09:E3:D8   or   8:0:20:9:E3:D8
08-00-20-09-E3-D8   or   08002009E3D8

00:00:0C:XX:XX:XX	**Cisco.**
08:00:20:XX:XX:XX	**Sun.**
08:00:09:XX:XX:XX	**HP**
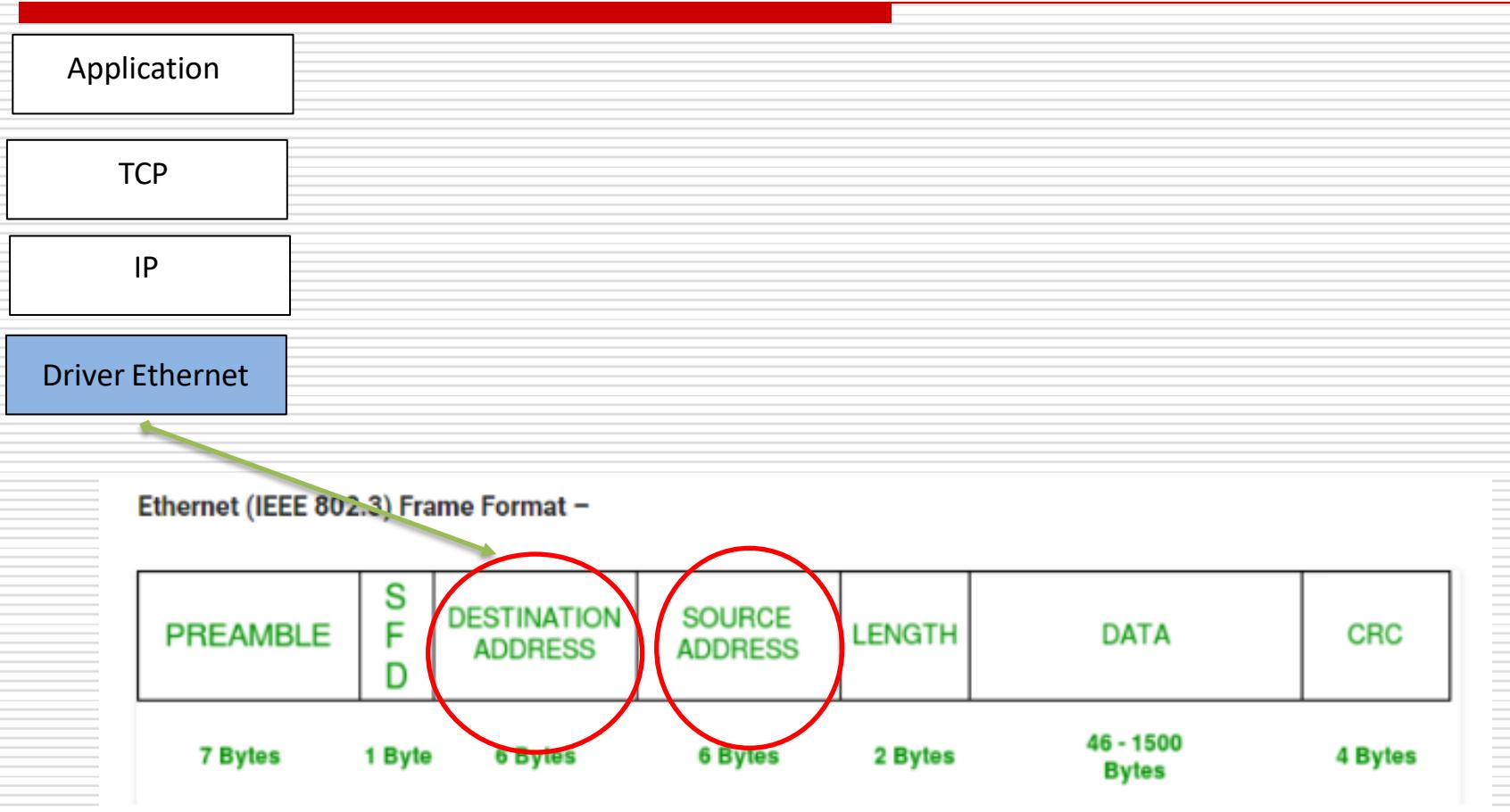
Structure of a MAC Address

3 Bytes: **prefix**   3 Bytes

Manufacturer Number	Serial Number

OID (Organizationally Unique Identifier)
manufacturer of the hardware

Assigned uniquely to each
device by the manufacturer

FF:FF:FF:FF:FF:FF

11111111:11111111:11111111:11111111:11111111:11111111

48 Bytes

MAC address

chassis number (or Vehicle Identification Number, VIN)

Ethernet frame

Application

TCP

IP

Driver Ethernet

Ethernet (IEEE 802.3) Frame Format –

PREAMBLE	S F D	DESTINATION ADDRESS	SOURCE ADDRESS	LENGTH	DATA	CRC
7 Bytes	1 Byte	6 Bytes	6 Bytes	2 Bytes	46 - 1500 Bytes	4 Bytes

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10

Specific MAC Addresses

Broadcast MAC Address: FF:FF:FF:FF:FF:FF

MAC source: **08:00:20:09:E3:D8**
MAC destination: **FF:FF:FF:FF:FF:FF**

MACa

MACa = 08:00:20:09:E3:D8

LAN

Specific MAC Addresses

It is commonly used in protocols like **ARP (Address Resolution Protocol)** or **DHCP (Dynamic Host Configuration Protocol)** for network discovery or configuration.

FF:FF:FF:FF:FF:FF

11111111:11111111:11111111:11111111:11111111:11111111

48 bits

Specific MAC Addresses
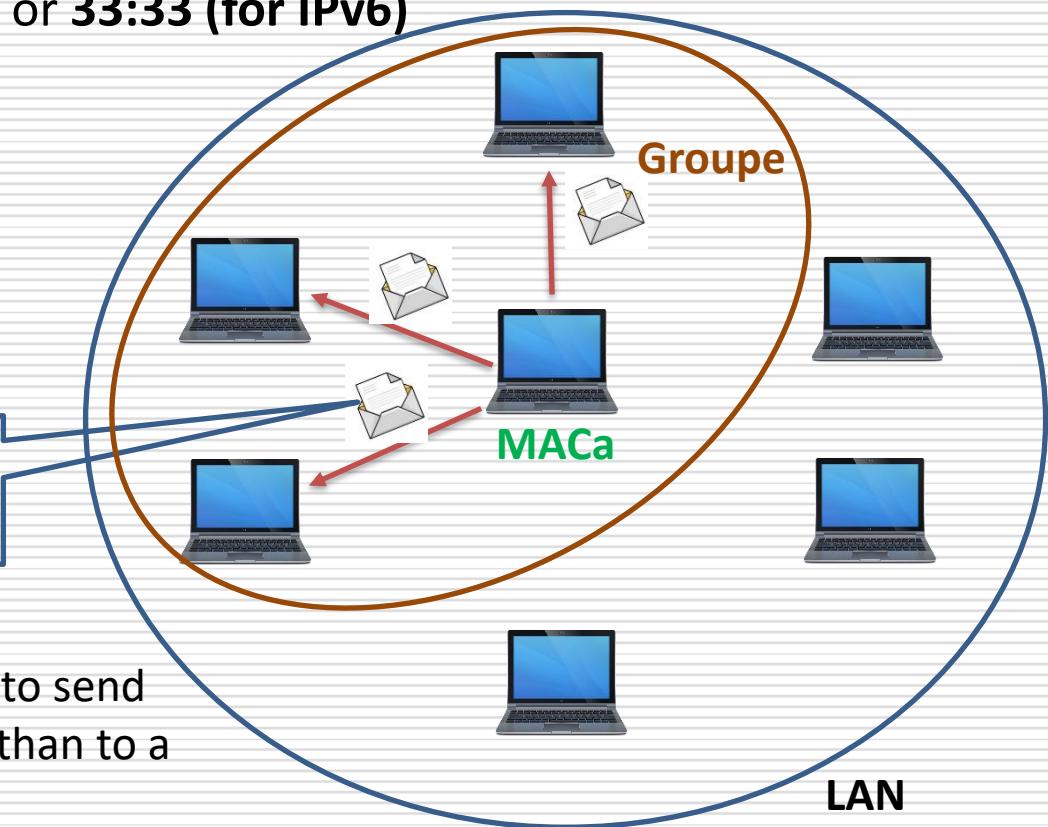
Multicast MAC Address: a special prefix: **01:00:5E (for IPv4)** or **33:33 (for IPv6)**

MAC source: **08:00:20:09:E3:D8**
MAC destination: **01:00:5E:00:00:01**

MACa = 08:00:20:09:E3:D8

Multicast MAC addresses are used to send frames to a **group of devices** rather than to a single device

Groupe

MACa

LAN
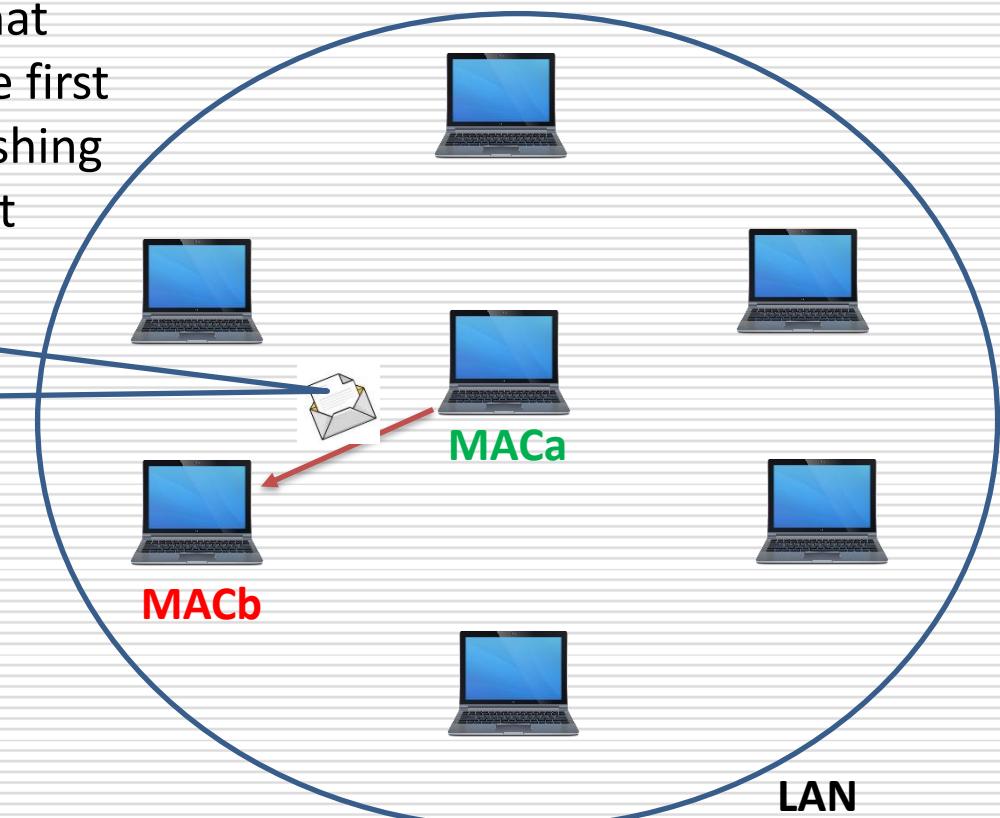
Specific MAC Addresses

unicast MAC address

refers to a specific MAC address that identifies a single network device. the first bit of the first byte set to 0, distinguishing them from multicast or broadcast addresses.

MAC source: **08:00:20:09:E3:D8**
MAC destination: **00:00:0C:00:01:30**

MACa = 08:00:20:09:E3:D8
MACb = 00:00:0C:00:01:30

MACa

MACb

LAN

Other Specific MAC Addresses

Locally Administered MAC Address: assigned to a device by software or a network administrator, overriding the burned-in address for physical devices. assigning the value of 1 to the second-least-significant bit of the first byte of the address: example address *06-00-00-00-00-00*

Special Management MAC Addresses: Some MAC addresses are specifically used for network management protocols or special network functions. For example 01:80:C2:00:00:00 is used for Spanning Tree Protocol (STP), which helps prevent loops in Ethernet networks.

Reserved MAC Addresses: Some MAC address ranges are reserved by IEEE and are not assigned to physical devices..

Other Specific MAC Addresses

| Type	I/G	U/L	OUI	OUA
Bit	1	2	3–24	25–48
Function	Recever: Unicast or broadcast	Point of issue	Manufacturer identification	Identifying the network adapter
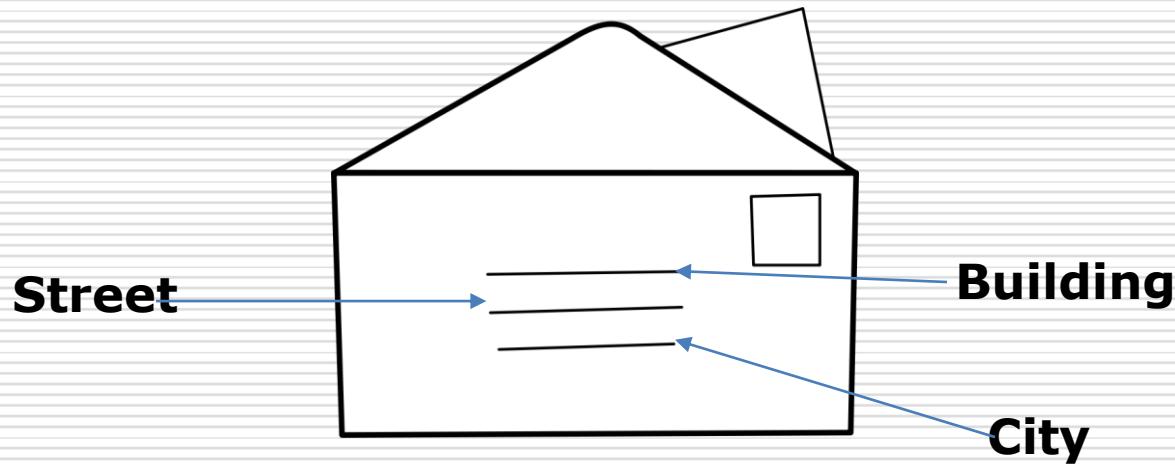
Other Specific MAC Addresses

MAC Address	Purpose	Description
FF:FF:FF:FF:FF:FF	Broadcast address	Used to send a frame to all devices on the local network.
01:80:C2:00:00:00	Ethernet Multicast (STP, BPDU)	Used by Spanning Tree Protocol and Ethernet bridging.
01:00:5E:00:00:00	IPv4 Multicast address	Used for IPv4 multicast communication.
00:1A:2B:XX:XX:XX	Organizationally Unique Identifier (OUI)	Identifies the manufacturer of the network device.
02:00:00:00:00:00	Locally administered MAC address	Custom MAC address configured by the user or network admin.
00:80:C2:00:00:00	Reserved for Future Use	Reserved for future or unspecified purposes by the IEEE.

Logical Addressing (IP)

IP Addressing

➤For routing data, it's necessary to identify the machines connected to the network.

➤The address must be organized like a postal address:

Street →   ← **Building**

                                 City

IP Addressing

➢The MAC address does not allow for network interconnection.

00:00:0C:00:01:30

08:00:20:09:E3:D8
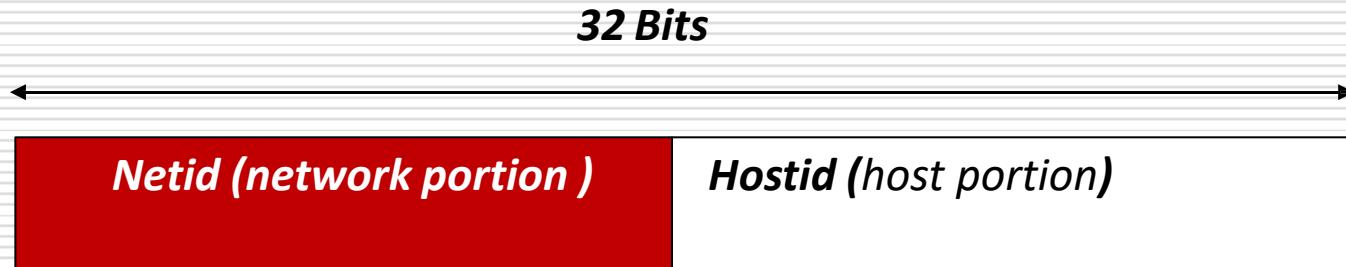
It is necessary to add a logical address in the **upper layer**, assigned by the **network administrator**.

IP Addressing


**Vehicle Registration Number**

IP Addressing

32 Bits

Netid (network portion)	Hostid (host portion)
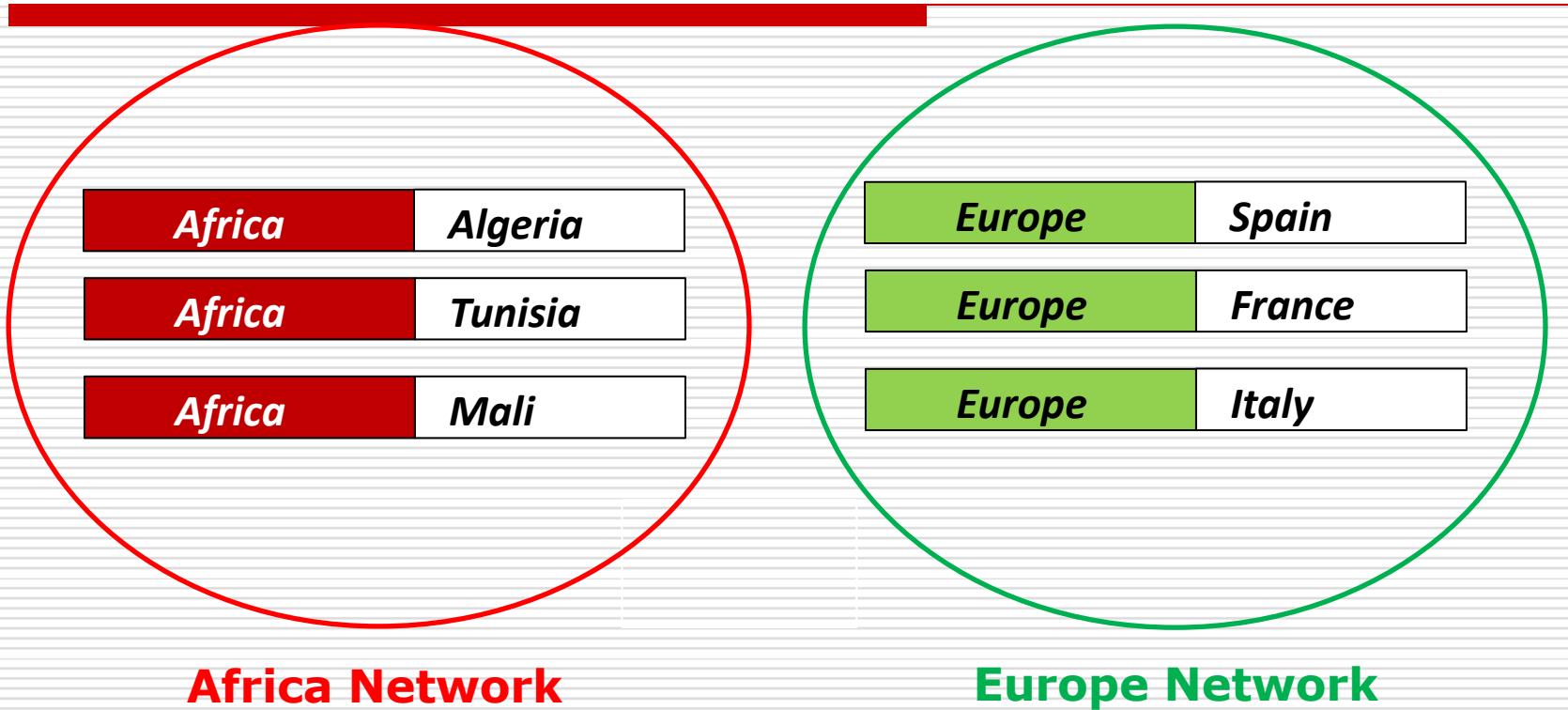
l'ICANN (Internet Corporation for Assigned Names and Numbers)

http://www.adresseip.com

IP Addressing

Africa	*Algeria*
Africa	*Tunisia*
Africa	*Mali*

Europe	*Spain*
Europe	*France*
Europe	*Italy*

Africa Network　　　　**Europe Network**

IP Addressing Example

32 Bits

8bits	8bits	8bits	8bits

11000000.10101000.00000001.00101010

192.168.1.42

Prepared by : Pr RIAHLA

Packet/Datagram IP

Application

TCP

IP

Driver Ethernet

32 bits

Version	Header length	Type of service	Datagram length (bytes)		
16-bit Identifier			Flags	13-bit Fragmentation offset	
Time-to-live		Upper-layer protocol	Header checksum		
32-bit Source IP address					
32-bit Destination IP address					
Options (if any)					
Data					

IP Addressing
IP Address Classes

	0	8	16	24	31

A	**0** **Netid**	**Hostid**

B	**1 0** **Netid**	**Hostid**

C	**1 1 0** **Netid**	**Hostid**

D	**1 1 1 0** **Multicast**

E	**1 1 1 1 0** **Réserved**

IP Address Classes
Class A

0	8	16	24	31

A	0	Netid	Hostid

Small Number of Networks and Many Machines

0.0.0.1 ⟶ 127.255.255.254

00000000.00000000.00000000.00000001 ⟶ 01111111.11111111.11111111.11111110

IP Address Classes
Class B

|			Netid			Hostid	
0		**8**		**16**		**24**	**31**

B | **1** **0** | Netid | Hostid |
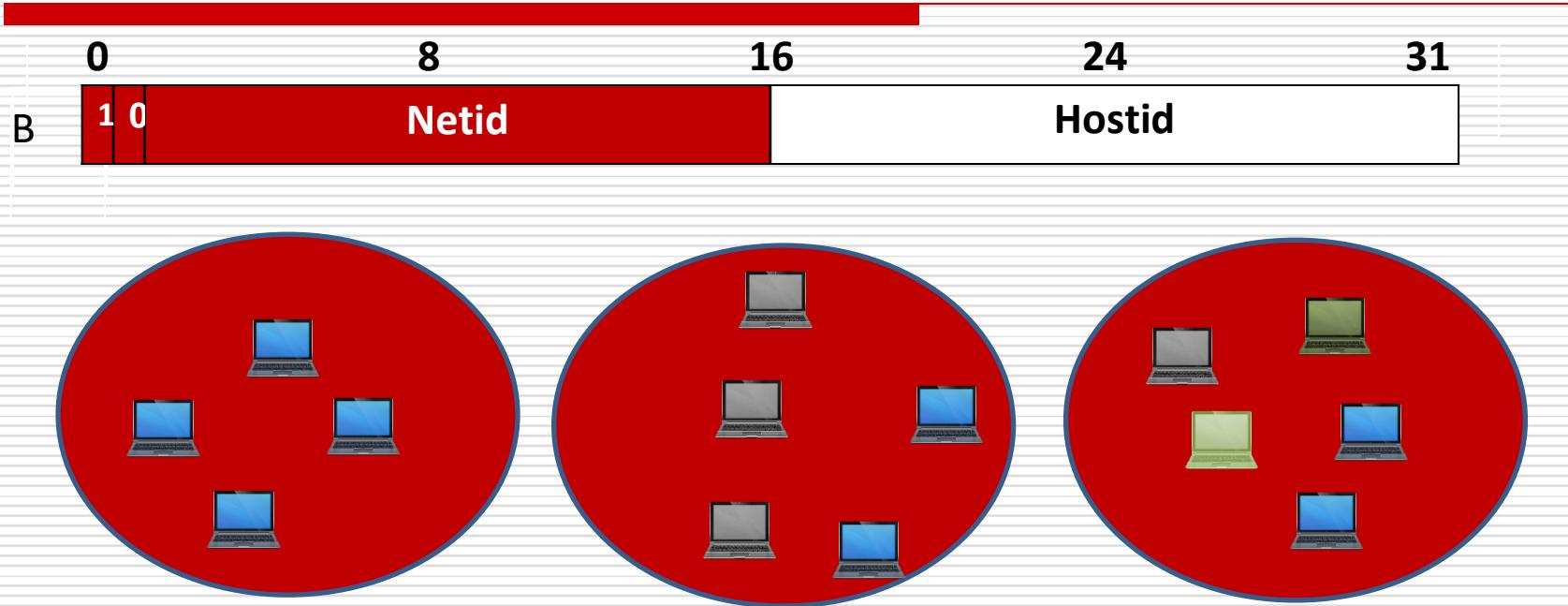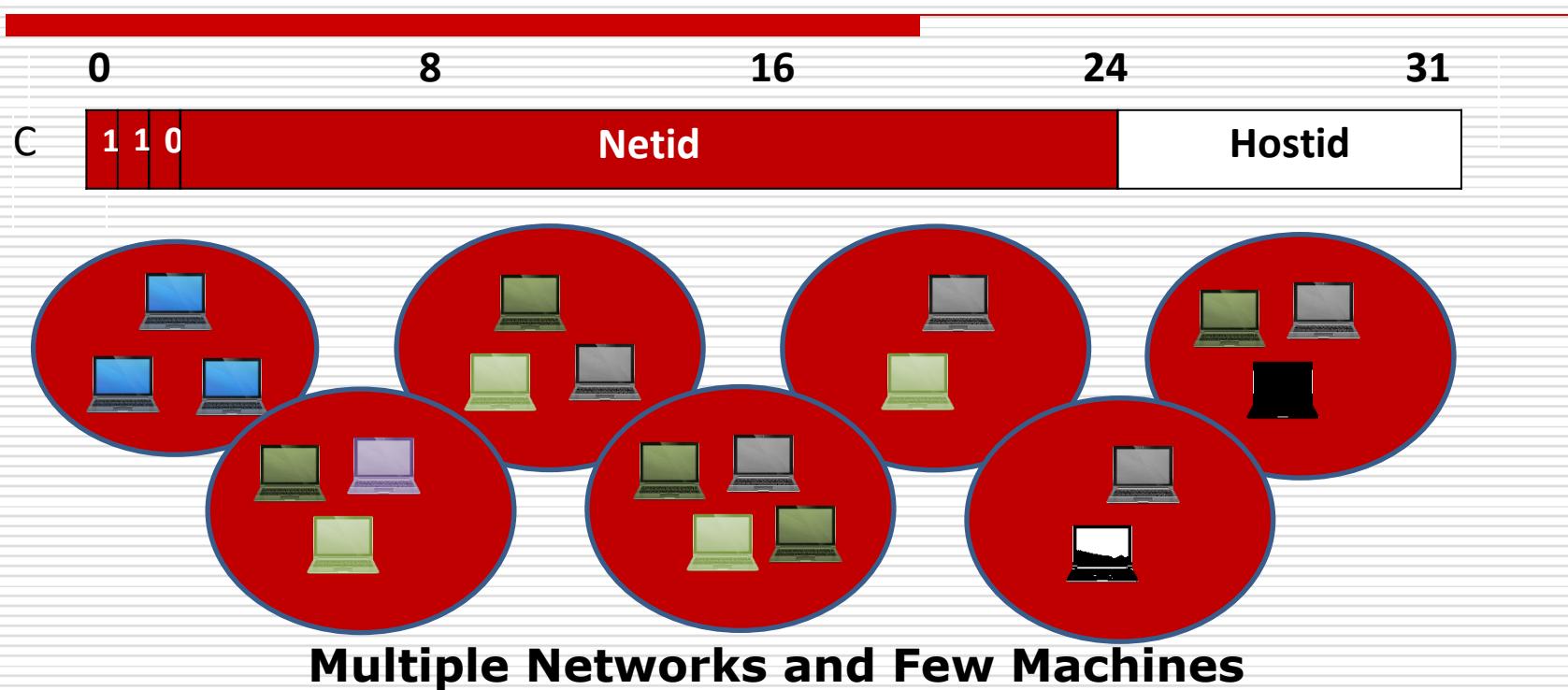
A Medium Number of Networks and Machines

128.0.0.1 ——————————→ 191.255.255.254

10000000.00000000.00000000.0000000**1** ——→ **10**111111.11111111.11111111.1111111**0**

IP Address Classes
Class C

		0		8		16		24		31

C	1 1 0	Netid	Hostid

Multiple Networks and Few Machines

192.0.0.1 ⟶ 223.255.255.254
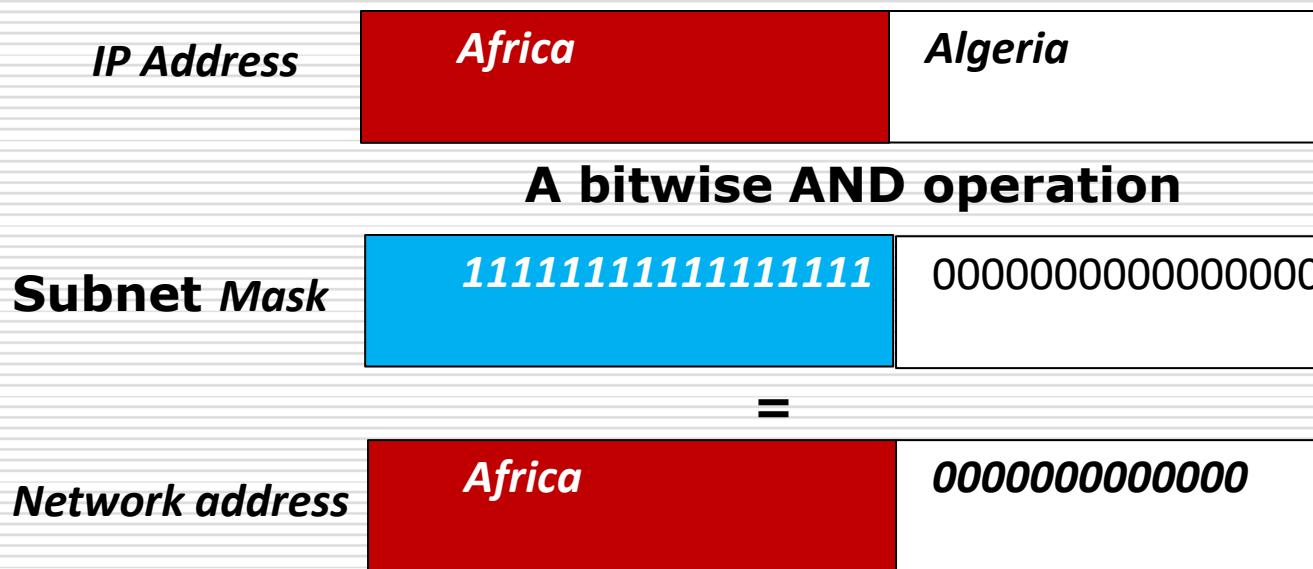
110**00000.00000000.00000000.0000000**1 ⟶ 110**11111.11111111.11111111.1111111**0

IP Address Classes
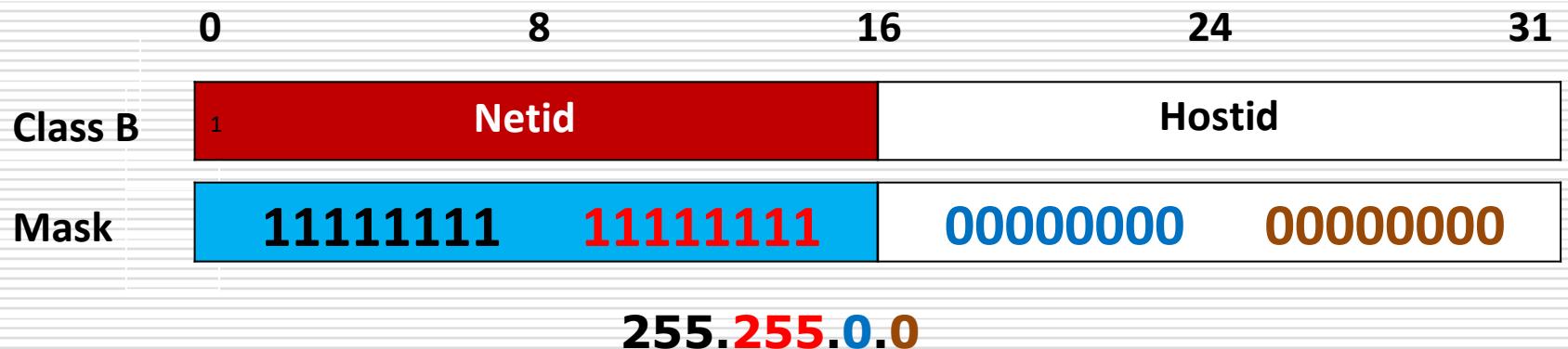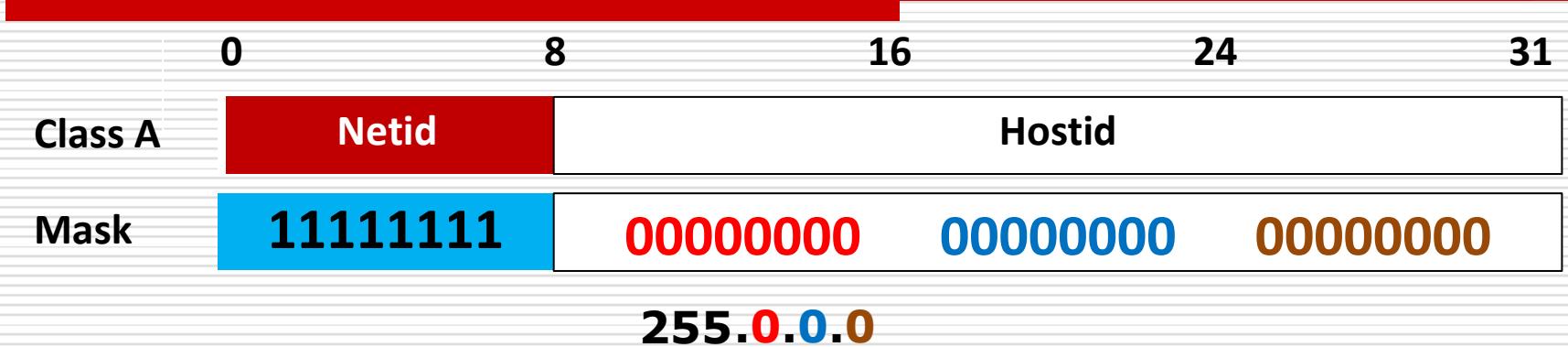
| Class	First address	Last address
A	0.0.0.1	127.255.255.254
B	128.0.0.1	191.255.255.254
C	192.0.0.1	223.255.255.254
D	224.0.0.1	239.255.255.254
E	240.0.0.1	247.255.255.254

Subnet Mask
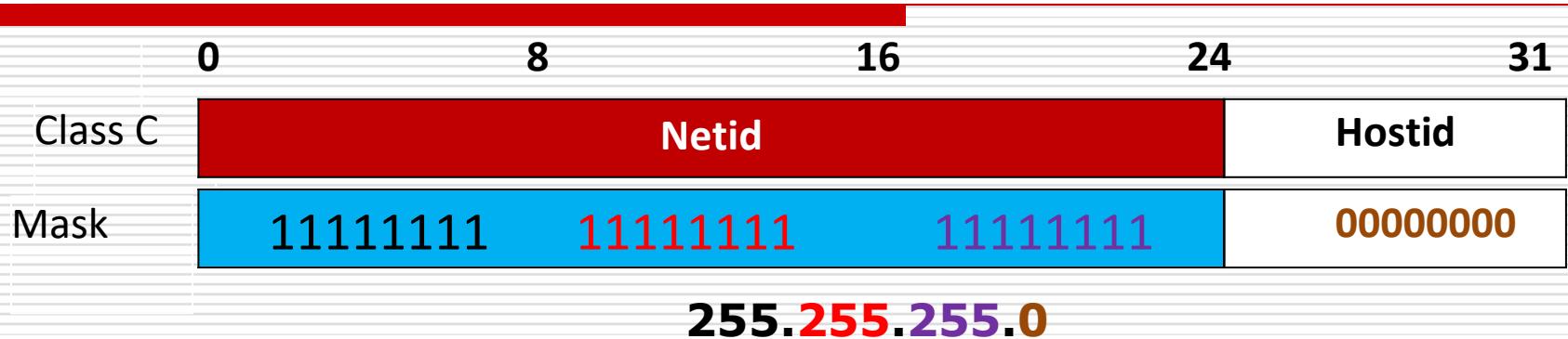
- Used to separate the network and host portions of an address.
- You obtain the network address by performing a bitwise AND operation between an IP address and the subnet mask.

IP Address	Africa	Algeria

A bitwise AND operation

Subnet *Mask*	1111111111111111	0000000000000000

=

Network address	Africa	00000000000

Default Subnet Mask

	0	8	16	24	31

Class A

Netid	Hostid

Mask

11111111	00000000	00000000	00000000

255.0.0.0

	0	8	16	24	31

Class B

Netid	Hostid

Mask

11111111	11111111	00000000	00000000

255.255.0.0

Default Subnet Mask

	0	8	16	24	31
Class C	Netid				Hostid
Mask	11111111	11111111	11111111		00000000

255.255.255.0

Class	Default subnet Mask
A	255.0.0.0
B	255.255.0.0
C	255.255.255.0

Specific IP addresses

Network Address: An IP address where the host portion (hostid) contains only zeros

Don't change		
	Network Address	*00000000000000*

Example

IP Adress	*Africa*	*Algeria*
Network Address	*Africa*	*00000000000000*

Specific IP addresses

Broadcast address: An IP address where the host portion (hostid) contains only ones

Don't change		
	Network Address	*1111111111111111*

Example

IP Adress	*Africa*	*Algeria*
Network Adress	*Africa*	*All countries!!!*

IP Addressing: Example

**Address of a machine:**   **192.168.100.1**
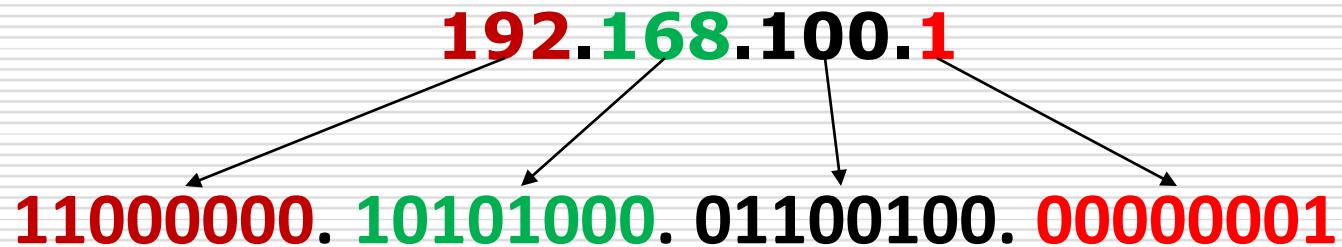
The subnet mask: ?????????

Where is the network part: ?????????

Where is the Host Party?:   ?????????

Network Address: ?????????

Broadcast address: ?????????

IP Addressing: Example

192.**168**.**100**.**1**

11000000. **10101000**. **01100100**. **00000001**

IP Addressing: Example subnet Mask?

Full address: **192.168.100.1**

What is the class of this Address?

Class C

11000000

192.0.0.1 → 223.255.255.254

IP Addressing: Example

Address of a machine: **192.168.100.1**

The subnet mask: 255.255.255.0

Where is the network part: ?????????

Where is the Host Part?:   ?????????

Network Address: ?????????

Broadcast address: ?????????

IP Addressing: Example Network/Machine part

0	**8**	**16**	**24**		**31**

Class C

Netid	Hostid

11000000. 10101000. 01100100. 00000001

Our Address: **192.168.100.1**

SO

Network Part: 192.168.100
Host Part: 1

IP Addressing: Example

Address of a machine: **192.168.100.1**

The subnet mask: 255.255.255.0

Where is the network part: 192.168.100
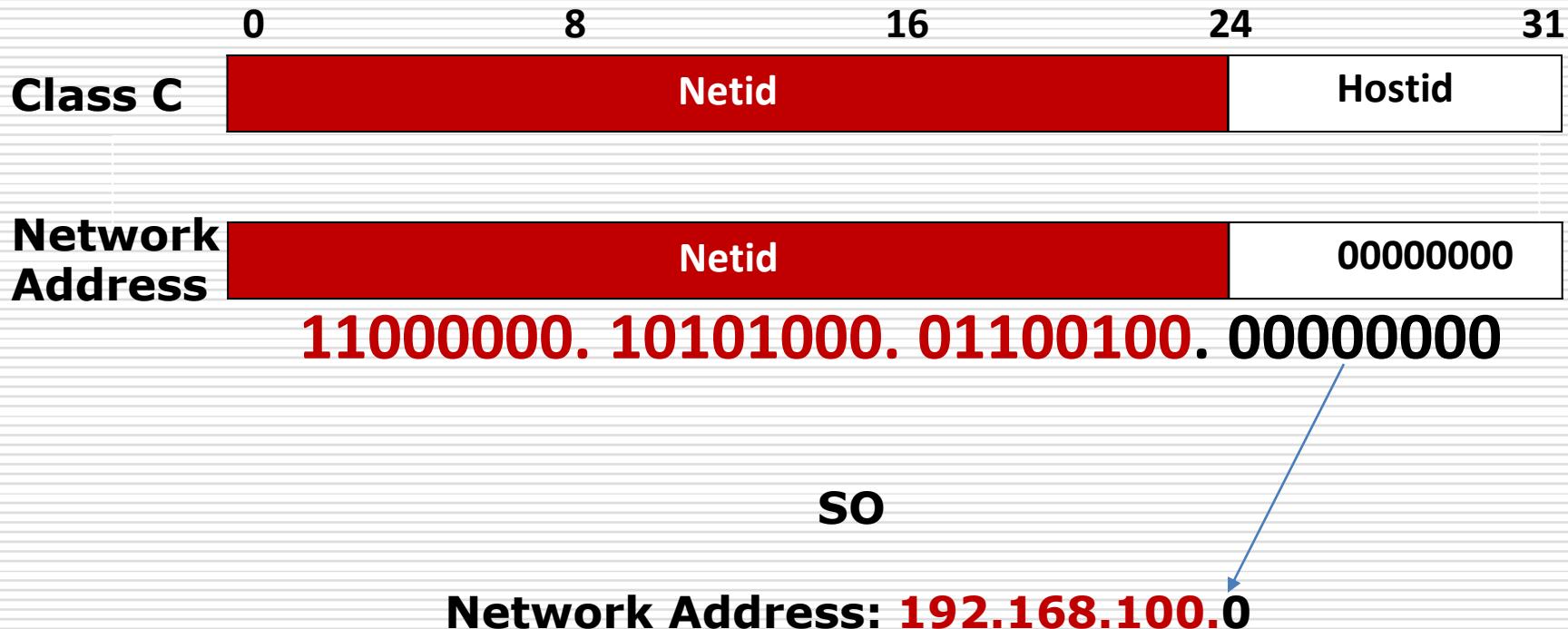
Where is the Host Part?:   1

Network Address: ?????????

Broadcast address: ?????????

IP Addressing: Example
Network Address

Our Address :   **192.168.100**.**1**

0	8	16	24	31

Class C	Netid	Hostid

Network Address	Netid	00000000

11000000. 10101000. 01100100. **00000000**

SO

Network Address: **192.168.100.****0**

IP Addressing: Example

Address of a machine: **192.168.100.1**

The subnet mask: 255.255.255.0

Where is the network part: 192.168.100

Where is the Host Part?:   1

Network Address: 192.168.100.0

Broadcast address: ????????

IP Addressing: Example
Broadcast Address

Our Adress :   **192.168.100**.1

	0	8	16	24	31

Class C

Netid	Hostid

Broadcast Address

Netid	11111111

11000000. 10101000. 01100100. 11111111

So

Broadcast: 192.168.100.255

IP Addressing: Example

Address of a machine: **192.168.100.1**

The subnet mask: 255.255.255.0

Where is the network part: 192.168.100

Where is the Host Part?:   1

Network Address: 192.168.100.0

Broadcast address: 192.168.100.255

IP Addressing: Example

We want to see that in reality
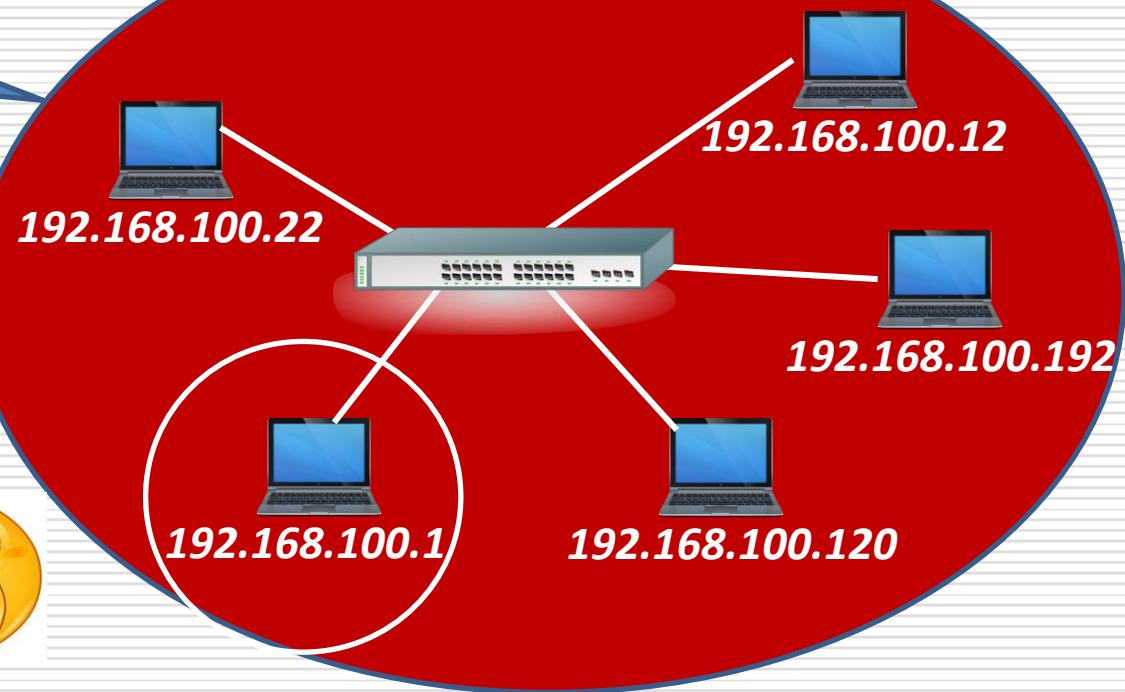
IP Addressing: Example
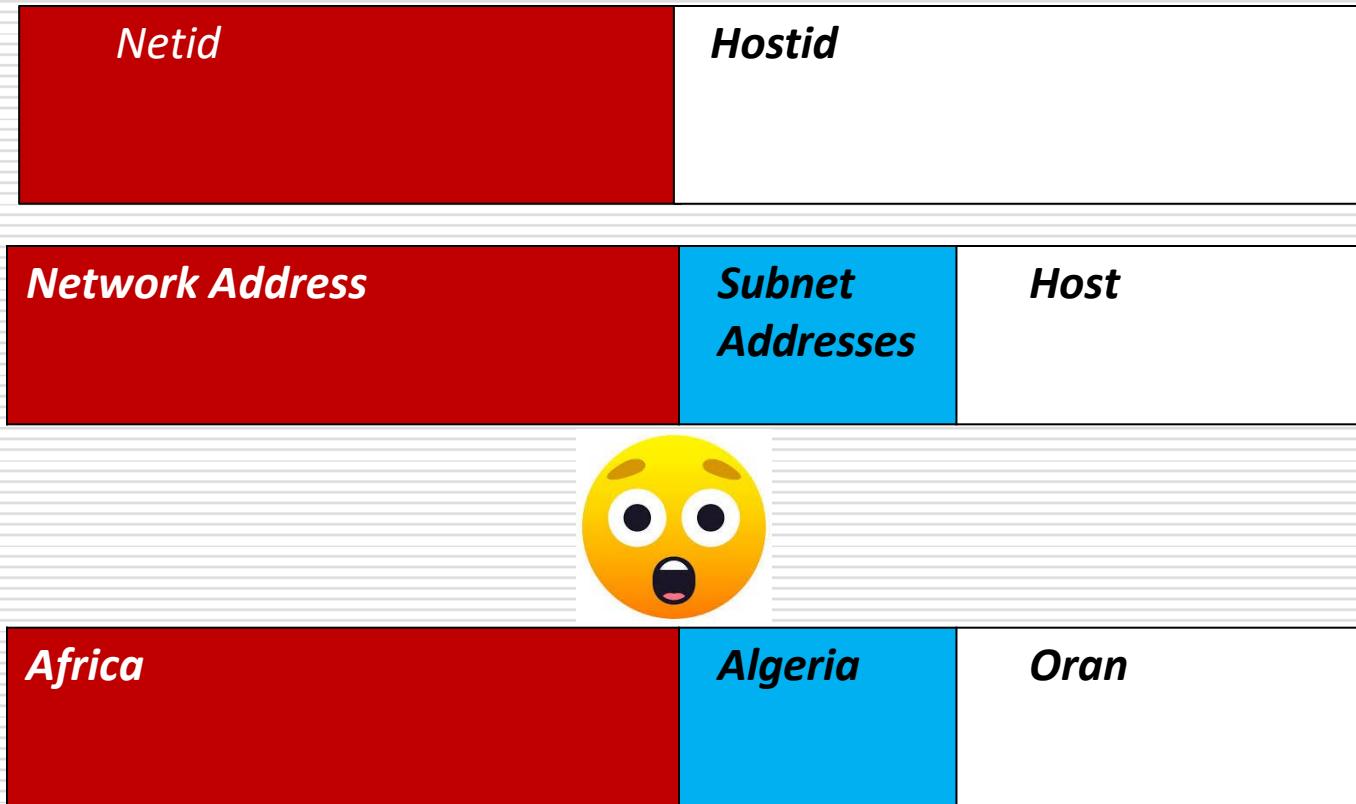
This network has the following address: 192.168.100.0

192.168.100.22

192.168.100.12

192.168.100.192

EOOOO, EVERYONE

192.168.100.255

192.168.100.1

192.168.100.120

Subnet Addresses

Netid	Hostid

Network Address	Subnet Addresses	Host

Africa	Algeria	Oran
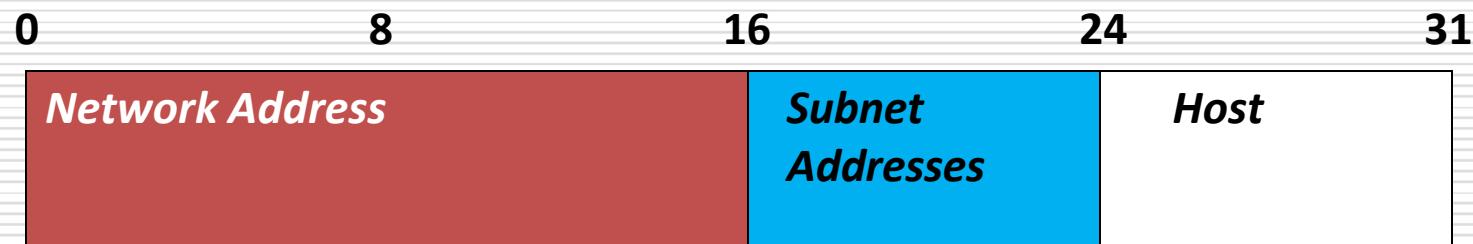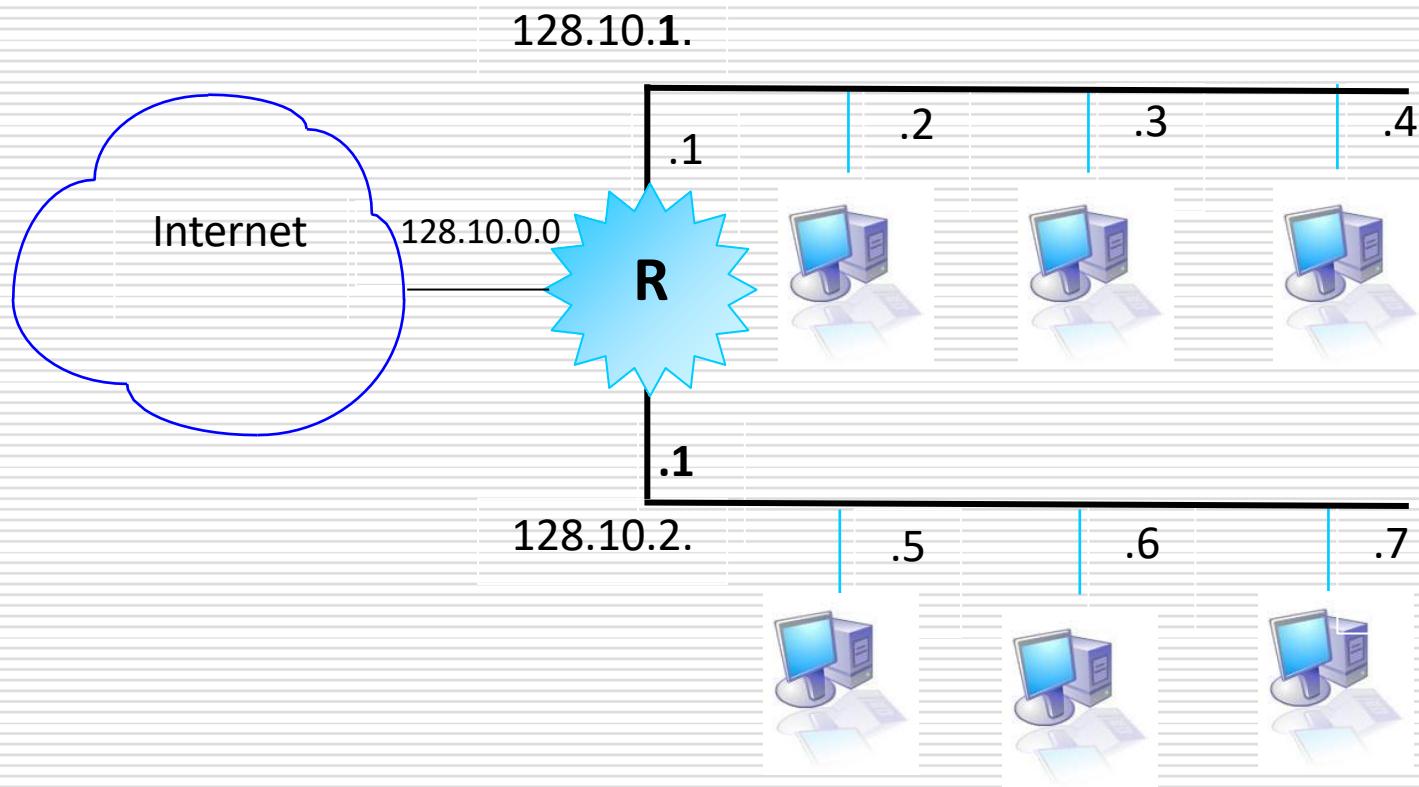
Subnet Addresses

Example: "Let's assume we have a Class B network. We therefore have two bytes available for host addresses, allowing for 65,534 possible hosts (the addresses x.x.0.0 and x.x.255.255 are reserved). This would result in a large number of machines on the same network.".

0	8	16	24	31

Network Address	Subnet Addresses	Host

Subnet Addresses

128.10.**1**.

Internet

128.10.0.0

.1

.1

R

.2

.3

.4

.1

128.10.2.

.5

.6

.7

Subnet Addresses Example

172.16.19.40/21

➢ What is the subnet mask for this address?

255.255.248.0

➢ How many bits have been reserved for private subnets?

5 bits

➢ How many private subnets are available?

32

➢ How many hosts can each subnet have?

2046

➢ What is the subnet address in the example?

172.16.16.0.

➢ "What is the broadcast address of the subnet in the example?

172.16.23.255

Subnet Addresses
Example

For the following address: 130.200.45.225, provide:

1. The address class:
2. The default network mask:
3. The network address:
4. The modified mask if the network has 60 subnets:
5. The subnet address and its number:
6. The machine number in the subnet:
7. The broadcast address for the machine:
8. The usable address ranges for the first two subnets:

Subnet Addresses
Example

Given the following network address: 192.10.10.0, the following subdivision is needed:
Number of required subnets: 14
Number of usable machines required: 14

a) **Address class:**
b) **Default mask:**
c) **Custom subnet mask:**
d) **Total number of subnets:**
e) **Total number of machine addresses:**
f) **Number of usable machine addresses:**
g) **Number of borrowed bits for the subnet:**
h) **What are the 4th and 9th subnet ranges?**
i) **What is the 8th subnet?**
j) **What is the broadcast address for the 13th subnet?**
k) **How many broadcast domains can be created?**

Subnet Addresses
Example

Given the following network address: 192.10.10.0, the following subdivision is needed:
Number of required subnets: 14
Number of usable machines required: 14

2- What is the last valid host address on the subnet 172.16.216.192/26?
3- What is the first valid host address on the subnet 172.25.10.18 255.255.248.0?
4- How many subnets and hosts per subnet can be obtained from the network 172.17.0.0 255.255.255.128?

Subnet Addresses
Example

1. **From a network ID and a desired number of subnets, calculate the subnet mask and the number of hosts per subnet:**

•**Network ID: 200.63.24.0 and 2 subnets:**
•**Network ID: 148.25.0.0 and 37 subnets:**
•**Network ID: 210.206.202.0 and 60 subnets:**

Subnet Addresses
Example

2. In this exercise, the maximum number of hosts per subnet is given. Calculate the subnet mask and the number of possible subnets.

•Network 222.53.25.0 and a maximum of 100 hosts per subnet:

•Network 10.0.0.0 and a maximum of 100 hosts per subnet:

•Network 223.21.25.0 and a maximum of 14 hosts per subnet:

Subnet Addresses
Example

3. Given an IP address and a subnet mask, determine the host IP range that includes this address.

•IP Address: 200.53.64.7 with the mask 255.255.255.0
•IP Address: 10.25.68.2 with the mask 255.255.224.0
•IP Address: 131.107.56.25 with the mask 255.255.248.0

Subnet Addresses
Example

4. **Which subnet includes the address 206.168.1.96 as a usable host address?**

- **206.168.1.32/28**
- **206.168.1.64/26**
- **206.168.1.32/27**
- **206.168.1.64/29**

Subnet Addresses
Example

5. A company has a network address of 203.16.1.64 with a subnet mask of 255.255.255.192. The company wants to create two subnets that will contain 10 hosts and 18 hosts, respectively. What are the two networks that will allow this?

- **203.16.1.64/27**
- **203.16.1.128/27**
- **203.16.1.16/28**
- **203.16.1.192/28**
- **203.16.1.96/28**

Subnet Addresses Example

6. What subnet mask allows hosting 510 hosts on the network with IP address 172.30.0.0?

- **255.255.0.0**
- **255.255.248.0**
- **255.255.252.0**
- **255.255.254.0**
- **255.255.255.0**
- **255.255.255.128**

Subnet Addresses Example

7. What IP address / subnet mask combination identifies the IP addresses between 191.50.128.0 and 191.50.159.255?

- **191.50.128.0 / 255.255.224.0**
- **191.50.128.0 / 255.255.255.224**
- **191.50.128.0 / 255.255.0.0**
- **191.50.128.0 / 255.255.192.0**
- **191.50.128.0 / 255.255.255.192**
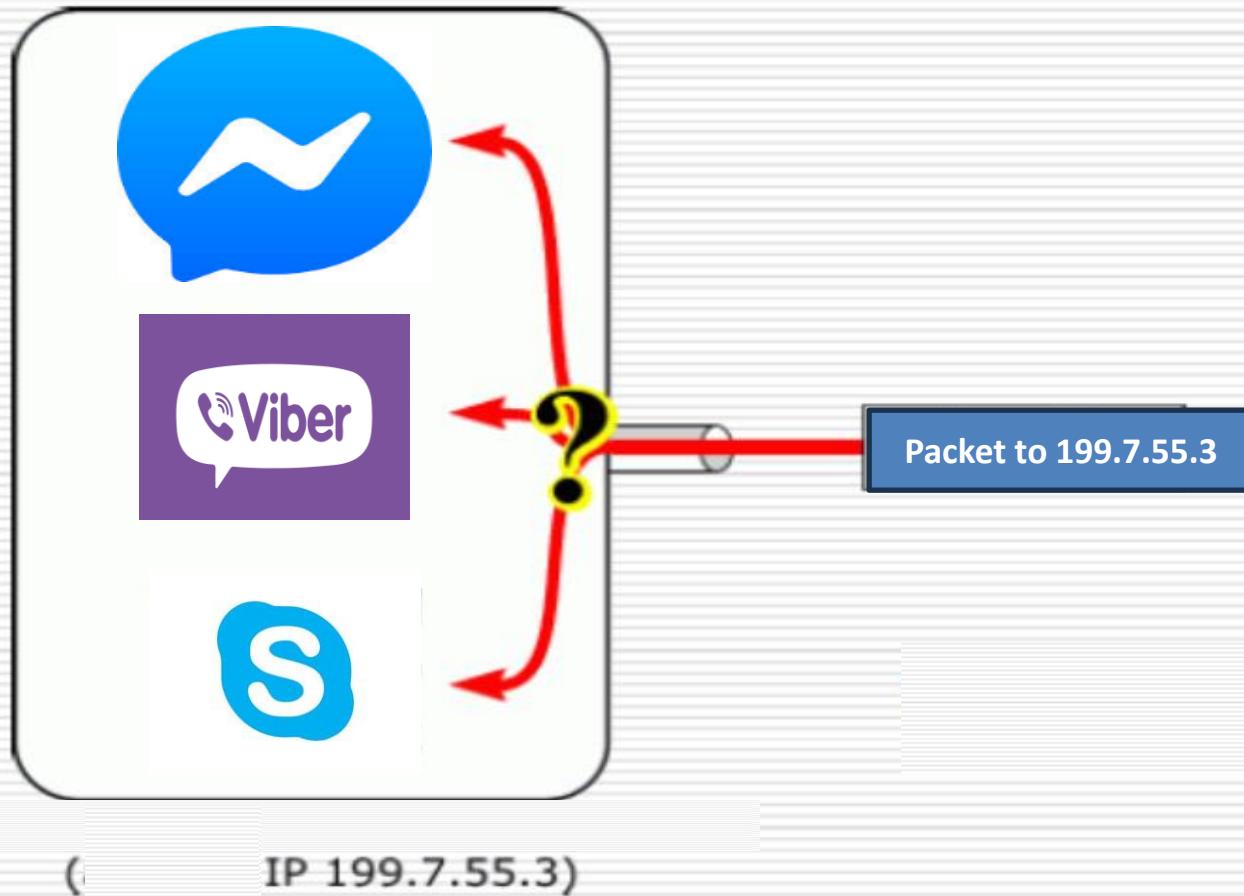
How to Design a private network ?

•**If the private network will NEVER be interconnected with others than You can use any address.**

•**Else The private network can be interconnected via a router interface. In this case, Reserved addresses for this purpose must be used :**
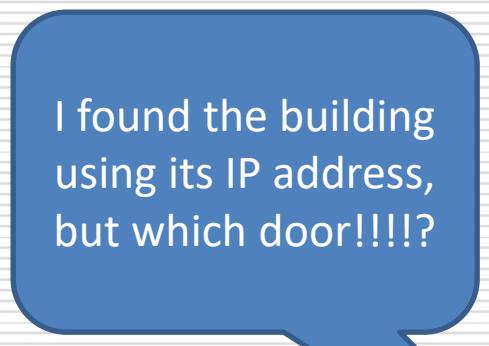
Class	Mask	Network address
A	255.0.0.0	10.0.0.0 - 10.255.255.255
B	255.255.0.0	172.16.0.0 - 172.31.255.255
C	255.255.255.0	192.168.0.0 - 192.168.255.255

# Network Addressing
Application Addressing (Port)

Port Number

Packet to 199.7.55.3

(IP 199.7.55.3)
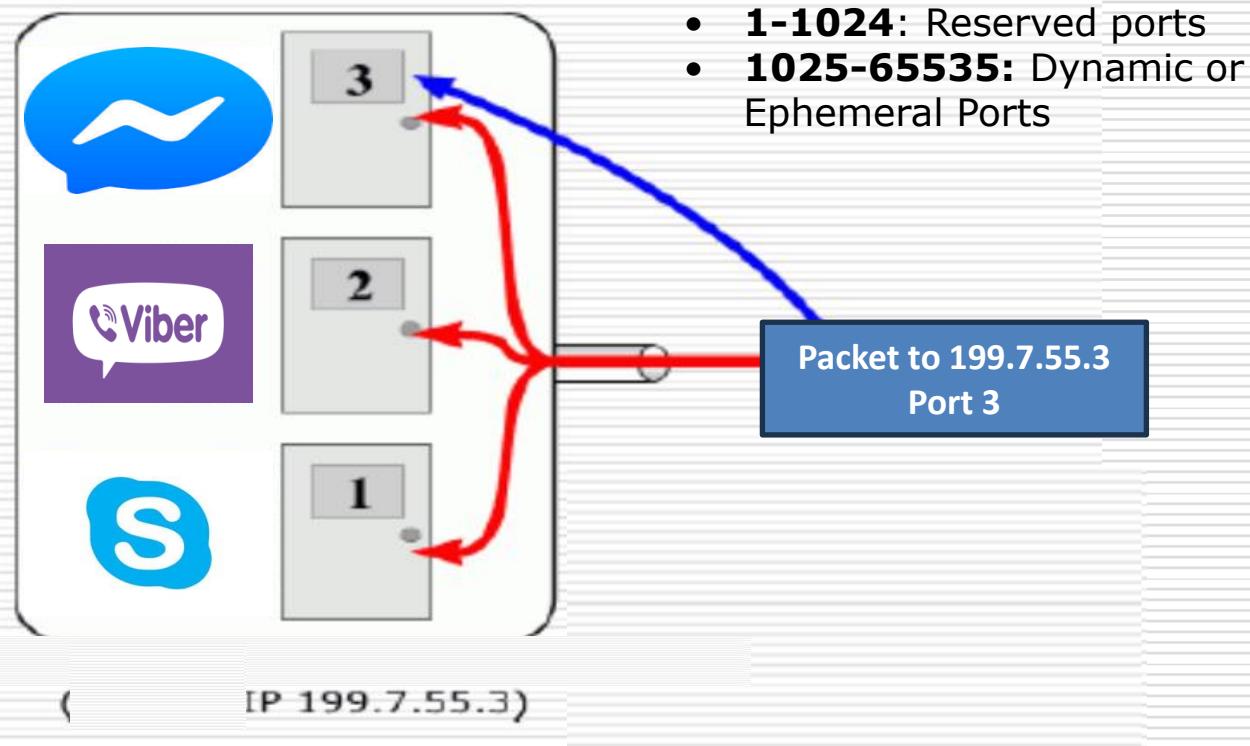
Port Number

Port Number

- Propose a numbering system for each application: ports.
- "This number is written using **2 bytes**, which gives **65,535** possible ports."

- **1-1024**: Reserved ports
- **1025-65535:** Dynamic or Ephemeral Ports

Packet to 199.7.55.3
Port 3

(IP 199.7.55.3)
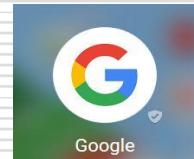
Port Number

"I want to search on Google, so: Destination Port: 80 (reserved for a web server)"

Port:80

Port:25

"Next time, I will send an email, so I will contact port 25."

Simulation